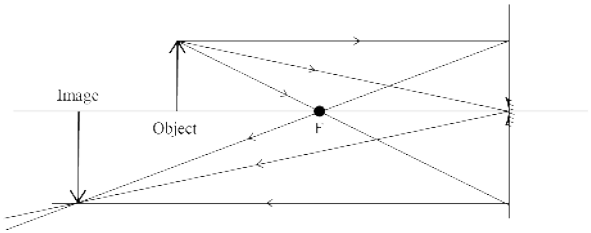
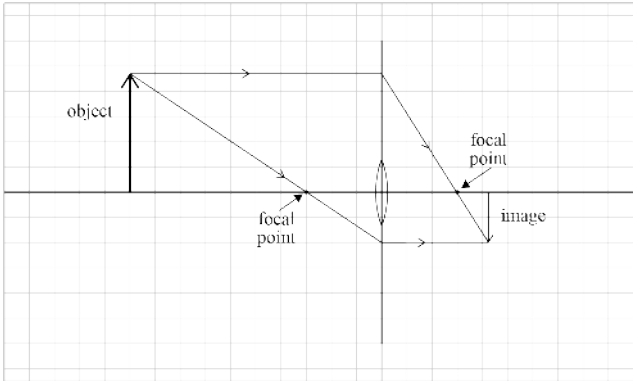
Assessment Schedule – 2017

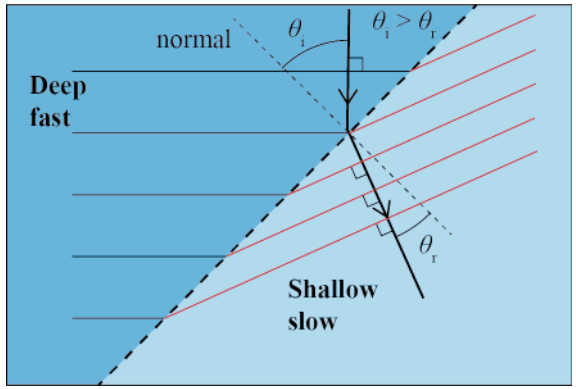
Physics: Demonstrate understanding of waves (91170)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	*Diagram is NOT to scale*  2 correct rays drawn, correct position of the image.	• Correct answer.		
(b)	$\frac{1}{d_i}-\frac{1}{d_o}=\frac{1}{f}$ $\frac{1}{d_i}-\frac{1}{140}=\frac{1}{80}$ $\frac{1}{d_i}=0.005357$ $d_i=187$ cm $h_i=20\times\frac{187}{140}=26.7$ cm + not – in 1st 2 lines	• Correct d_i. OR Uses $h_i=h_o\times\frac{d_i}{d_o}$ with incorrectly calculated d_i.	• Correct height.	

(c)	The image formed by the concave mirror is inverted, enlarged, and real. The image formed by the convex mirror is upright, diminished, and virtual. Convex mirrors are diverging mirrors, which means no real light rays intersect on the same side of the mirror as the light source. This means all images in a convex mirror are virtual. All virtual images are upright and diminished. The image formed by the convex mirror is diminished because (virtual) rays travel less before they appear to meet. A concave mirror is a converging mirror, which means real light rays will intersect (if the object is beyond the focal point), creating a real image which is inverted and enlarged. The image formed by concave mirror is enlarged because reflected rays travel longer before they meet. (There are many more correct reasons for different aspects of the images.)	• Two aspects of both types of mirror images are described. OR Two aspects of one type of mirror image are described, and the reason for one aspect is explained correctly. OR One aspect described for each type of mirror, and the reason explained correctly for each aspect.	• Two aspects of both types of mirror images are described. AND One aspect of both types of mirror images is explained correctly.	
(d)(i) (ii)	The image distance is negative, as the image formed is virtual. The image is × 3, so the image distance is × 3 of the object distance from the mirror. Or mathematically: $m = \frac{d_i}{d_o} = \frac{h_i}{h_o} \rightarrow \frac{d_i}{d_o} = \frac{-60}{30} = -3$ so $d_i = -3d_o$ $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $\frac{1}{d_o} - \frac{1}{3d_o} = \frac{1}{80}$ $\frac{2}{3d_o} = \frac{1}{80}$ $d_o = 53.3$ cm (20 not 30)	The image is virtual. OR Image distance is negative. OR Idea that the magnification $m = 3$, so the image distance is × 3 of the object distance ($d_i = 3d_o$)	• Idea that the magnification $m = 3$, so the image distance is × 3 of the object distance. AND The idea that the image distance is negative as the image formed is virtual. OR Missed negative sign with correct follow-on working, obtaining an answer of 107 cm.	• Correct answer.

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $1.55 \times \sin 40° = n_2 \times \sin 44.0°$ $n_2 = 1.43$	• Correct working shown (correct substitution).		
(b)	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $1.55 \times \sin \theta_c = 1.43 \times \sin 90^0$ $\sin \theta_c = \frac{1.43}{1.55}$ $\theta_c = 67.7°$ <-> $67.3°$ (depending on rounding)	• Correct formula and correct substitution.	• Correct answer and correct s.f.	
(c)(i)	Two correct rays and a focal point is labelled  	• Two correct rays are drawn. OR One correct ray and one focal point.	• Two correct rays are drawn, and a focal point is labelled. AND Correct focal length.	
(ii)	Focal length = 1.5 cm			
(d)	The lens could be moved closer to the object, or the object closer to the lens, so the object lies within the focal length of the lens to make a virtual, enlarged, and upright image. A thinner / less curved lens could be used (one with a much larger radius of curvature), so the object becomes within the focal length. The refractive index of the glass could be decreased so its focal length increases, and then the object becomes within the focal length.	• One correct statement out of three given. • 1/. Bring O within F 2/. Decrease lens curvature so that f > 5cm 3/. decrease refractive index of lens material to same effect.	• Two correct statements. For Merit, candidates need to give reasons. (Providing one more statement than required for Achievement is not appropriate.)	• All three correct statements. (Ditto comment to Merit.)

Q	Evidence	Achieved	Merit	Excellence
THREE (a)	$f = \frac{3}{15} = 0.20$ Hz $v = f\lambda = 0.2 \times 18 = 3.6$ m s^{-1}	• Correct v.		
(b)(i)	Refracted waves (red lines) bend towards the boundary, only red lines required.  	• Refracted waves bend towards the boundary. OR The wavelength is shorter than in deep water, but constant. OR $\lambda = \frac{v}{f} = \frac{3.0}{0.2} = 15$ m	• Refracted waves bend towards the boundary. AND The wavelength is shorter than in deep water, but constant. AND $\lambda = \frac{v}{f} = \frac{3.0}{0.2} = 15$ m	
(ii)	The wavelength is shorter than in deep water, and constant. $\lambda = \frac{v}{f} = \frac{3.0}{0.2} = 15$ m OR $\frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} \rightarrow \frac{3.6}{3.0} = \frac{18}{\lambda_2} \rightarrow \lambda_2 = 15$ m			
(c)	Light waves have shorter wavelength, and sound waves have longer wavelength. Longer wavelengths diffract more around larger obstacles (like the cliff), so sound waves diffract more and can be heard.	• Light waves have shorter wavelength, and sound waves have longer wavelength. OR Longer wavelengths diffract more around larger obstacles (like the cliff), so sound waves diffract more and can be heard.	• Both statements.	

(d)	Louder sound is heard where waves from two sources constructively interfere because the path difference between two sound waves is $n\lambda$, so the total amplitude of the resultant wave increases, creating a louder sound. Quieter sound is heard where waves from two sources destructively interfere because the path difference between two waves is ½λ, so the total amplitude decreases, creating a quiet sound.	• The idea that the loud sound is heard where sound waves from two sources constructively interfere or a crest lies on a crest. OR The quiet sound is heard where two waves destructively interfere, or a crest lies on a trough.	• BOTH constructive and destructive interference explained AND linked to EITHER • Path difference of waves. • Amplitude/volume of resultant waves.	• ALL points covered.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at the Achievement level, but most is at the Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at the Achievement level.	Some evidence is at the Merit level.	A majority of the evidence is at the Merit level.	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks and the evidence at the Excellence level is accurate.
-	1a	2a	3a	4a	1m + 3a	2m + 2a	1e+ 2m	1e + 2m + 1a

Other combinations are also possible. (Using a=1; m=2; e=3) However, for M5 or M6 at least one Merit question needs to be correct. For E7 or E8 at least one Excellence needs to be correct.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 18	19 – 24